PATENT ABSTRACTS OF JAPAN

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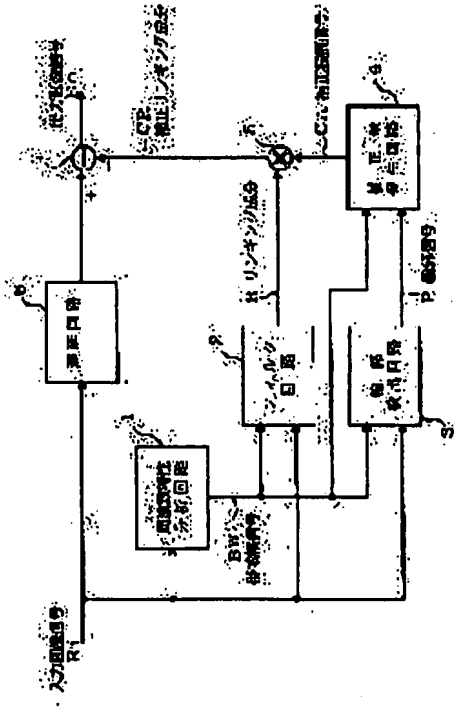
(72)Inventor : ASHIBE MINORU

(54) RINGING ELIMINATING DEVICE

(57)Abstract:

PURPOSE: To provide the ringing eliminating device which can eliminate effectively ringing even if a cut-off frequency of an input image signal is unknown.

CONSTITUTION: By a frequency characteristic analyzing circuit 1, a frequency characteristic of an input image signal Ei is analyzed and its signal band width BW is measured. A repeat period of ringing roughly coincides with a cut-off frequency of the input image signal, therefore, by adjusting the frequency characteristic of a filter circuit 2 in accordance with the measured band width BW, a ringing component R is extracted. By using the band width BW, a contour signal P for showing a contour part of the input image signal Ei is generated by a contour detecting circuit 3. Since ringing is conspicuous in a peripheral part of a contour, a correction amount CA in the peripheral part of the contour is generated, based on the contour signal P. By its correction amount CA, the ringing component R is corrected, and the correction ringing component CR is eliminated from the input image signal Ei delayed for the purpose of phase matching.



LEGAL STATUS

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rejection]

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[Date of final disposal for application]	
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[Date of registration]	11.04.1997
[Number of appeal against examiner's decision of rejection]	08-016253
[Date of requesting appeal against examiner's decision of rejection]	19.09.1996
[Date of extinction of right]	

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the ringing stripper which removes a ringing from an input picture signal A bandwidth detection means to detect the bandwidth of said input picture signal, and a filter means to change frequency characteristics according to said bandwidth, and to extract a ringing component from said input picture signal, A profile detection means to detect the profile signal showing the profile section of said input picture signal, An amount generation means of amendments to generate the amount of amendments of the periphery of said profile based on said profile signal, a removal means to amend said ringing component based on the amount of amendments of said profile periphery, and to remove said amendment ringing component from said input picture signal -- since -- the ringing stripper characterized by becoming.
[Claim 2] the maximum frequency detector which detects the maximum frequency as said bandwidth among the frequencies which have an accumulation value beyond the frequency changing circuit where said bandwidth detection means changes said input picture signal into two or more frequency components, the accumulation circuit which carries out predetermined period accumulation of each of said frequency component, and the predetermined value of said frequency component -- since -- the ringing stripper according to claim 1 characterized by becoming.
[Claim 3] a selection means by which said bandwidth detection means chooses one from said two or more bandwidth detectors according to two or more bandwidth detectors where detection bands differ, and the source of a signal of said input picture signal -- since -- the ringing stripper according to claim 1 characterized by becoming.
[Claim 4] the maximum frequency detector which detects the maximum frequency as said bandwidth among the frequencies which have an accumulation value beyond the frequency changing circuit where each of two or more of said bandwidth detectors changes said input picture signal into two or more frequency components, the accumulation circuit which carries out predetermined period accumulation of each of said frequency component, and the predetermined value of said frequency component -- since -- the ringing stripper according to claim 3 characterized by becoming.
[Claim 5] Said filter means is a ringing stripper according to claim 1 to 4 characterized by having the multiplier selection circuitry which is a digital filter and chooses the group of a filter factor according to said bandwidth.
[Claim 6] two or more delay circuits where said profile detection means delays 1 pixel of said input picture signals at a time and by which series connection was carried out, the selection circuitry which chooses one output of each delay output of two or more of said delay circuits according to said bandwidth, and the difference circuit which calculates the difference of said input picture signal and said selected delay output -- since -- the ringing stripper according to claim 1 to 5 characterized by to become.
[Claim 7] Said profile detection means is a ringing stripper according to claim 1 to 5 characterized by inputting said ringing component from said filter means, extracting the zero crossing point, and generating said profile signal.

[Claim 8] The adjustable low pass mold filter which said amount generation means of amendments can change cut-off frequency according to said bandwidth, and extracts a low-pass component from said profile signal, The profile extract circuit which extracts only the profile section from said profile signal, and the amount generation circuit of amendments which removes said profile part from the filter output of said adjustable low pass mold filter, and generates the amount of amendments of said profile periphery, since -- the ringing stripper according to claim 1 to 7 characterized by becoming.
[Claim 9] the multiplication circuit which said removal means carries out the multiplication of said ringing component and amount of amendments of said profile periphery, and generates said amendment ringing component, and the subtractor circuit which deducts said amendment ringing component from said input video signal -- since -- the ringing stripper according to claim 1 to 8 characterized by becoming.
[Claim 10] Said input video signal deducted in said subtractor circuit is a ringing stripper according to claim 9 characterized by being delayed in order to adjust a phase with said amendment ringing component.
[Claim 11] In the ringing stripper which removes a ringing from an input picture signal A bandwidth detection means to detect the bandwidth of said input picture signal, and a filter means to change frequency characteristics according to said bandwidth, and to extract a ringing component from said input picture signal, A profile detection means to detect the profile signal showing the profile section of said input picture signal, A magnitude-of-attenuation generation means to generate the magnitude of attenuation of the periphery of said profile based on said profile signal, an addition means to add a multiplication means to carry out the multiplication of said ringing component and magnitude of attenuation of said profile periphery, and to generate an amendment ringing component, and the result of having subtracted said ringing component from said input picture signal and said amendment ringing component -- since -- the ringing stripper characterized by becoming.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the ringing stripper which removes the ringing component which starts the picture signal processor for high-definition-izing an image, especially is contained in a picture signal.
[0002]
[Description of the Prior Art] There is a profile intensifier indicated by JP,4-83477,A as a technique of removing the ringing component already contained in the picture signal. Although this technique is originally related with profile emphasis of a picture signal, it also has the operation effectiveness of removing a ringing component.
[0003] Drawing 10 is the rough block diagram showing the circuitry indicated by the above-mentioned open official report. In this drawing, the profile extract circuit 1001 extracts the profile section from the input picture signal Ei with the technique based on difference temporarily. Inputting it, the gain control signal generation circuit 1002 classifies an image into the profile section, a profile periphery, and other parts, and generates the gain control signal which has a value according to this classification. Here, the gain control signal of a profile periphery is set as a negative value.
[0004] On the other hand, the input picture signal Ei is inputted into the profile emphasis component extract circuit 1003, and the signal component near the cut-off frequency is extracted. The multiplication of this signal component and the gain control signal is carried out by the multiplier 1004, that result is added to the input picture signal Ei by the adder 1005, and the output picture signal Eo is acquired.
[0005] Since the gain control signal of a profile periphery is set as the negative value, the signal component near [used as a ringing] the cut-off frequency is decreased only by the profile periphery, and the output picture signal Eo with which the ringing component was removed is acquired.
[0006]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned Prior art, since the profile emphasis component extract circuit 1003 needed the filtering function which passes the signal component near the cut-off frequency, when the cut-off frequency of the input picture signal Ei was strange, it had the problem that a ringing was effectively unremovable. For example, when transmitting a picture signal through the transmission line where a property is strange, effective ringing removal cannot be performed.
[0007] Even if the purpose of this invention has the strange cut-off frequency of an input picture signal, it is to offer the ringing stripper which can remove a ringing effectively.
[0008]
[Means for Solving the Problem] A bandwidth detection means by which the ringing stripper by this invention detects the bandwidth of an input picture signal, A filter means to change frequency characteristics according to bandwidth and to extract a ringing component from an input picture signal, A profile detection means to detect the profile signal showing the profile section of an input picture signal, and an amount generation means of amendments to generate the amount of amendments of a

profile periphery based on a profile signal, a removal means to remove the ringing component which amended the ringing component with the amount of amendments of a profile periphery, and was amended from the input picture signal -- since -- it is characterized by becoming.

[0009]

[Function] With a bandwidth detection means, the frequency characteristics of an input picture signal are analyzed and the signal bandwidth is measured. Since the repeat period of a ringing is mostly in agreement with the cut-off frequency of an input picture signal, it can extract a ringing component with the filter means which adjusted frequency characteristics according to the measured bandwidth. Since it tends to be conspicuous by the periphery of a profile, a ringing generates the amount of amendments of a profile periphery based on a profile signal, with the amount of amendments, amends a ringing component and removes it from an input picture signal.

[0010]

[Example] Hereafter, the example of this invention is explained to a detail, referring to a drawing.

[0011] Drawing 1 is the block diagram showing the 1st example of the ringing stripper by this invention. In this drawing, the input picture signal Ei is inputted into the frequency-characteristics analysis circuit 1, a filter circuit 2, and the profile detector 3, respectively. The frequency-characteristics analysis circuit 1 measures the signal bandwidth of the input picture signal Ei, generates the bandwidth signal BW, and outputs it to a filter circuit 2 and the profile detector 3.

[0012] A filter circuit 2 extracts the signal component near [which the bandwidth signal BW shows to the input picture signal Ei] the frequency, and outputs it as a ringing component R. moreover, the profile detector 3 -- the bandwidth signal BW -- being based -- the input picture signal Ei -- it asks for the primary difference and outputs to the amount generating circuit 4 of amendments by making this into the profile signal P.

[0013] The amount generating circuit 4 of amendments inputs the bandwidth signal BW and the profile signal P, and generates the amendment amplitude signal CA with which a value becomes large by the periphery of a profile based on the profile signal P. A multiplier 5 carries out the multiplication of the amendment amplitude signal CA from the amount generating circuit 4 of amendments to the ringing component R from a filter circuit 2, and generates the amendment ringing component CR.

[0014] On the other hand, although the input picture signal Ei can give required delay by the delay circuit 6, it supports elapsed time until, as for this time delay, the input picture signal Ei to the amendment ringing component CR is generated by the above-mentioned processing.

[0015] A subtractor 7 deducts the amendment ringing component CR from the picture signal delayed by the delay circuit 6, and outputs the output picture signal Eo with which the ringing component was removed.

[0016] Next, the detailed example of a configuration of each above-mentioned circuit is shown.

[0017] Drawing 2 is the block diagram showing an example of the configuration of the frequency-characteristics analysis circuit 1 in this example. the maximum frequency detector 103 which the frequency-characteristics analysis circuit 1 detects the maximum frequency among the conversion circuit 101 which performs frequency conversion, the integrating circuit 102 which accumulates every frequency component, and the component which has an accumulation value beyond a predetermined value, and outputs the bandwidth signal BW -- since -- it is constituted.

[0018] Frequency conversion of the input picture signal Ei is carried out by the conversion circuit 101 with the Fourier transform, and it is sent out to an integrating circuit 102. In an integrating circuit 102, each frequency component for one screen is accumulated respectively, and is sent out to the maximum frequency detector 103, for example. In the maximum frequency detector 103, the maximum frequency is outputted as a bandwidth signal BW among the frequency components which have an accumulation value beyond a predetermined value.

[0019] Drawing 3 is the block diagram showing an example of the configuration of the filter circuit 2 in this example. Although a filter circuit 2 is a filter which extracts the signal component near [which the bandwidth signal BW shows] the frequency from the input picture signal Ei and a well-known technique can realize, the symmetry mold FIR filter of seven taps is explained as an example here.

[0020] In this drawing, the input picture signal Ei carries out a sequential input in six delay circuits 201-206 by which series connection was carried out, and is delayed 1 clock (here 1 pixel) every in each delay circuit. The signal respectively outputted from delay circuits 201-206 is set to z-1, z-2, z-3, z-4, z-5, and z-6.
[0021] In the case of a 7 tap symmetry mold FIR filter, the same filter factor as order contrast can take advantaging focusing on the signal z-3 delayed 3 pixels, i.e., the output signal from a delay circuit 203. Therefore, in order to reduce the count of multiplication, the signal value by which the same filter factor can multiply is beforehand added respectively with adders 207-209, and these addition result is respectively multiplied by filter factors alpha1-alpha3 with multipliers 210-212. A filter factor alpha 0 can multiply by the signal z-3 of the delay circuit 203 which takes the lead with a multiplier 213. The signal by which each filter factor was able to multiply is added with an adder 214, and outputs the result as a ringing component R. That is, the ringing component R is expressed by the degree type.
[0022] R=alpha 0z-3+alpha1(z-2+z-4)+alpha2(z-1+z-5)+alpha3 (1+z-6).
[0023] Filter factors alpha0-alpha3 are outputted from the multiplier selection circuitry 215. The multiplier selection circuitry 215 has two or more sets of multiplier values beforehand, for example, chooses 1 set of multiplier values from the inside according to the value of the bandwidth signal BW, and outputs them as filter factors alpha0-alpha3.
[0024] Drawing 4 is the block diagram showing an example of the configuration of the profile detector 3 in this example. the profile detector 3 -- the bandwidth signal BW -- being based -- the input picture signal Ei -- it asks for the primary difference and this is outputted as a profile signal P.
[0025] In this drawing, a sequential input is carried out, delay for 1 pixel is given to two or more delay circuits 301-303 by which series connection was carried out in each delay circuit, and the input picture signal Ei inputs all of the delay output of these delay circuits into a selection circuitry 304.
[0026] Based on the bandwidth signal BW, a selection circuitry 304 is the selection criterion of choosing little delay output of the amount of delay, so that bandwidth is narrow, chooses one signal from the delay output signals of delay circuits 301-303, and outputs it to a difference circuit 305. In addition, selection precision can be raised by carrying out over sampling technique beforehand, in case the amount of delay is chosen.
[0027] In a difference circuit 305, the delay output signal chosen by the selection circuitry 304 is deducted from the input picture signal Ei, and the primary differential signal according to the bandwidth signal BW is acquired. Since the amount of delay changes with bandwidth signals BW, a differential delay is adjusted in the delay equalization circuit 306, absolute value processing of this primary differential signal is carried out with an absolute-value circuit 307 at the last, and the profile signal P is acquired (see (a) of drawing 6 , and the (b)).
[0028] Drawing 5 is the block diagram showing an example of the configuration of the amount generating circuit 4 of amendments in this example. The amount generating circuit 4 of amendments consists of a subtractor 403 for taking out the clipping circuit 402 for extracting only the adjustable low pass mold filter circuit (only henceforth LPF) 401 and the profile section to which cut-off frequency can be changed with the bandwidth signal BW, and a profile periphery, and a clipping circuit 404, and generates the amendment amplitude signal CA with which a value becomes large by the periphery of a profile based on the profile signal P.
[0029] The profile signal P is inputted into LPF401 and a clipping circuit 402 in this drawing. LPF401 changes cut-off frequency according to the bandwidth signal BW, and outputs the filter output LP to a subtractor 403. A clipping circuit 402 deducts a predetermined value from the profile signal P, and outputs the clip output CLP which clipped the negative value in zero to a subtractor 403. In a subtractor 403, the clip output CLP is deducted from the filter output LP, when the result is negative, in a clipping circuit 404, it clips in zero, and it is outputted as an amendment amplitude signal CA. In addition, a clipping circuit 404 not only clips a negative value in zero, but may prepare a forward upper limit.
[0030] Drawing 6 is a signal waveform diagram for explaining concrete actuation of the amount generating circuit 4 of amendments. The input picture signal Ei containing a ringing as shown in this drawing (a) inputs, and suppose that the profile signal P (this drawing (b)) was generated by the profile

detector 3. The filter output LP as shown in this drawing (c) with the cut-off frequency according to the bandwidth signal BW in this profile signal P inputting into LPF401 is obtained. The profile signal P inputs into coincidence in a clipping circuit 402, a predetermined value is deducted, and the clip output CLP as the zero clip of the negative value carried out and shown in this drawing (d) is obtained. And the clip output CLP is deducted from the filter output LP, and the amendment amplitude signal CA of a profile periphery as shows a negative value in this drawing (e) by carrying out a zero clip is acquired.

[0031] In this way, as shown in drawing 1 , with a multiplier 5, the multiplication of the acquired amendment amplitude signal CA is carried out to the ringing component R, and it serves as the amendment ringing component CR. Since the amendment ringing component CR is increasing by the profile periphery as the amendment amplitude signal CA shows drawing 6 (e), it serves as a wave approximated to the ringing component contained in the input picture signal Ei. This amendment ringing component CR is deducted from the input picture signal Ei delayed by the delay circuit 6 by the subtractor 7.

[0032] The ringing component generated in the profile periphery is effectively removed from the input picture signal Ei by the above processing, and can acquire the high-definition output picture signal Eo without a ringing by it.

[0033] This invention cannot be restricted to the 1st example shown in drawing 1 , and can be carried out by other configurations shown below.

[0034] Drawing 7 is the block diagram showing the 2nd example of the ringing stripper by this invention. In this example, the frequency-characteristics analysis circuit 1, a filter circuit 2, and the amount generating circuit 4 of amendments are the same circuits as the 1st example shown in drawing 1 .

[0035] The ringing component R outputted from a filter circuit 2 is inputted into the profile circuit 701 and a delay circuit 702. The profile circuit 701 extracts the zero crossing point of the ringing component R as a profile signal P1, and outputs it to the amount generating circuit 4 of amendments. The amount generating circuit 4 of amendments inputs the bandwidth signal BW and the profile signal P1, and generates the amendment amplitude signal CA 1 like the 1st example.

[0036] A delay circuit 702 delays the ringing component R, and performs the amendment amplitude signal CA 1 and phase adjustment which are the input of another side of a multiplier 5. In a multiplier 5, the multiplication of the amendment amplitude signal CA 1 is carried out to the ringing component R, and the amendment ringing component CR 1 is generated.

[0037] On the other hand, although the input picture signal Ei can give required delay by the delay circuit 703, it supports elapsed time until, as for this time delay, the input picture signal Ei to the amendment ringing component CR 1 is generated by the above-mentioned processing. A subtractor 7 deducts the amendment ringing component CR 1 from the input picture signal Ei delayed by the delay circuit 703, and outputs the output picture signal Eo with which the ringing component was effectively removed like the 1st example.

[0038] Drawing 8 is the block diagram showing the 3rd example of the ringing stripper by this invention. This example is equivalent to the 1st example of drawing 1 , and circuitry was only changed. Namely, in this example, the frequency-characteristics analysis circuit 1, a filter circuit 2, and the profile detector 3 are the same as that of the 1st example, and differ from each other in that changed the amount generating circuit 4 of amendments of the 1st example into the magnitude-of-attenuation generating circuit 801, and the magnitude-of-attenuation signal ATT was used instead of the amendment amplitude signal CA.

[0039] Although the magnitude-of-attenuation generating circuit 801 inputs the profile signal P and the bandwidth signal BW and generates the magnitude-of-attenuation signal ATT, the relation of ATT=1-CA between the magnitude-of-attenuation signal ATT and the amendment amplitude signal CA of the 1st example is. Therefore, the magnitude-of-attenuation signal ATT serves as a wave of drawing 6 (e) with a small value by the periphery of a profile conversely.

[0040] In a multiplier 5, the multiplication of the magnitude-of-attenuation signal ATT and the ringing component R is carried out, and they serve as one input of an adder 804. Moreover, a delay circuit 802

deducts the ringing component R from the input picture signal Ei which only the time amount equivalent to the amount of delay in a filter circuit 2 delayed [picture signal] the input picture signal Ei, and delayed it with the subtractor 803, and serves as an input of another side of an adder 804. In this way, the output from an adder 804 serves as the output picture signal Eo with which the ringing component was removed effectively like the 1st example.

[0041] The thing of a configuration of being shown in drawing 9 may be used for the frequency-characteristics analysis circuit 1 in each above-mentioned example. This frequency-characteristics analysis circuit 1 has two or more analysis circuits 104-106 where frequency bands differ, operates a switcher 107 and a selection circuitry 108 based on the selection signal from the outside, and chooses a suitable analysis circuit. The fundamental configuration of the analysis circuits 104-106 is the same as that of what is shown in drawing 2 , and good.

[0042] Thus, by forming two or more analysis circuits 104-106, the picture signal from two or more sources of a signal which received a different frequency band limit can be inputted, each bandwidth signal BW can be generated, and effective ringing removal can be performed to each input picture signal.

[0043] In addition, although each above-mentioned example explained horizontal ringing removal of an image, this invention is perpendicularly applicable similarly.

[0044]

[Effect of the Invention] As explained to the detail above, in order to perform frequency analysis of an input picture signal, to extract a ringing component and a profile signal based on the analysis result and to perform ringing removal of a profile periphery based on them, even if the ringing stripper by this invention is the case that the cut-off frequency of an input picture signal is strange, it can perform ringing removal effectively.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the 1st example of the ringing stripper by this invention.
[Drawing 2] It is the block diagram showing an example of the configuration of the frequency-characteristics analysis circuit 1 in this example.
[Drawing 3] It is the block diagram showing an example of the configuration of the filter circuit 2 in this example.
[Drawing 4] It is the block diagram showing an example of the configuration of the profile detector 3 in this example.
[Drawing 5] It is the block diagram showing an example of the configuration of the amount generating circuit 4 of amendments in this example.
[Drawing 6] It is a signal waveform diagram for explaining concrete actuation of the amount generating circuit 4 of amendments.
[Drawing 7] It is the block diagram showing the 2nd example of the ringing stripper by this invention.
[Drawing 8] It is the block diagram showing the 3rd example of the ringing stripper by this invention.
[Drawing 9] It is the block diagram showing other examples of a configuration of the frequency-characteristics analysis circuit 1.
[Drawing 10] It is the rough block diagram showing an example of the conventional ringing stripper.
[Description of Notations]
1 Frequency-Characteristics Analysis Circuit
2 Filter Circuit
3 Profile Detector
4 The Amount Generating Circuit of Amendments
5 Multiplier
6 Delay Circuit
7 Subtractor
101 Frequency Changing Circuit
102 Integrating Circuit
103 Maximum Frequency Detector
201-206 Delay circuit
207-209 Adder
210-213 Multiplier
214 Adder
215 Multiplier Selection Circuitry
301-303 Delay circuit
304 Selection Circuitry
305 Difference Circuit
306 Delay Equalization Circuit
307 Absolute-value Circuit

401 Low Pass Mold Filter Circuit
402 Clipping Circuit
403 Subtractor
404 Clipping Circuit
701 Profile Circuit
702 Delay Circuit
703 Delay Circuit
801 Magnitude-of-Attenuation Generating Circuit

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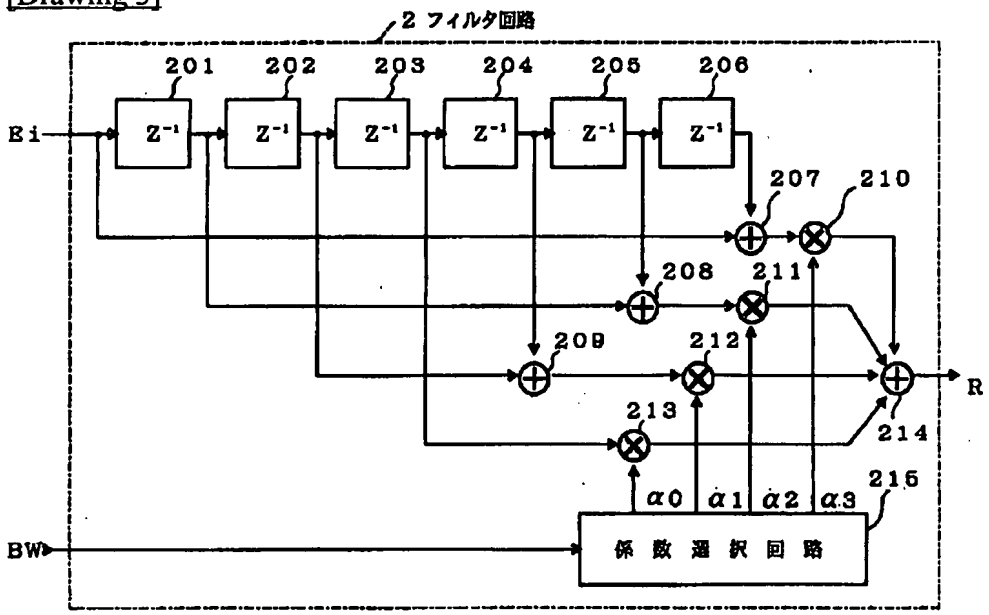
DRAWINGS

[Drawing 3]



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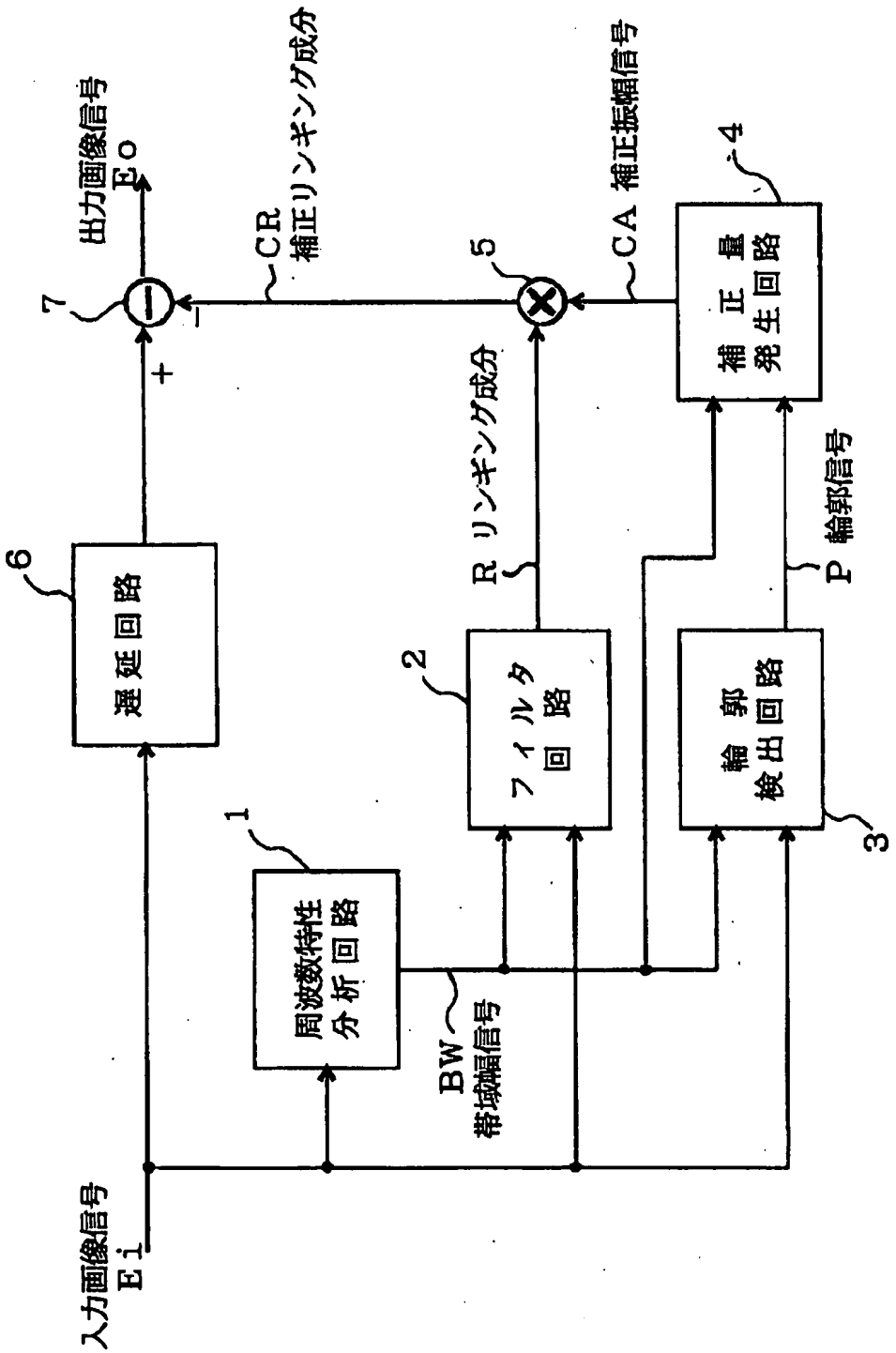
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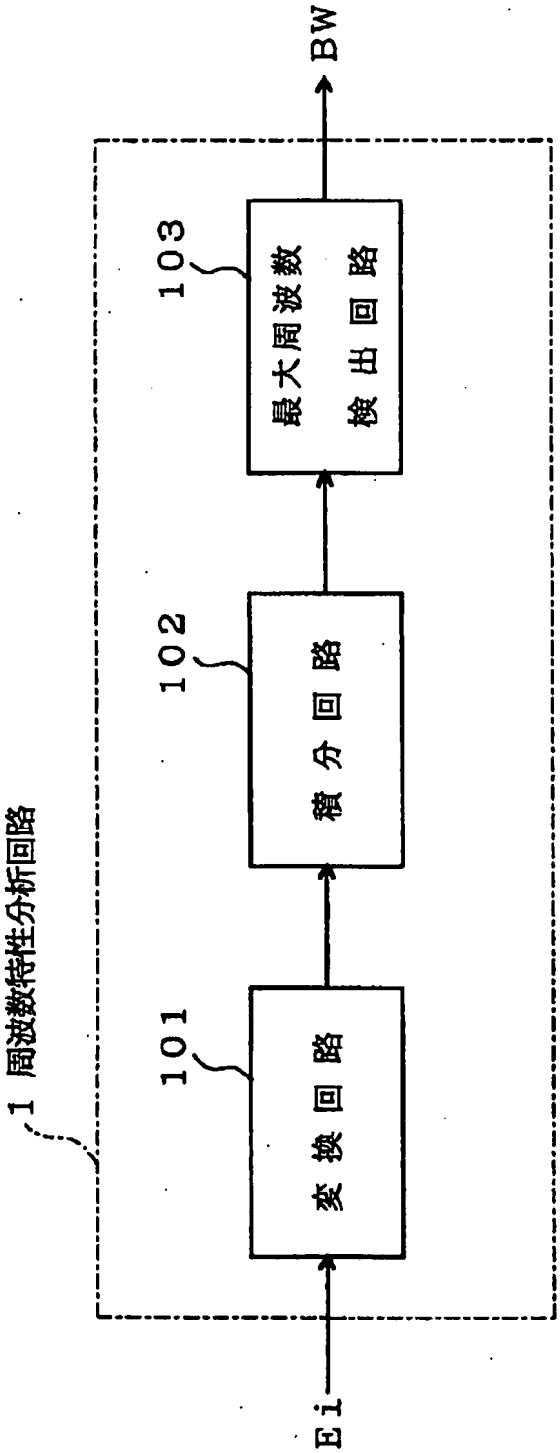

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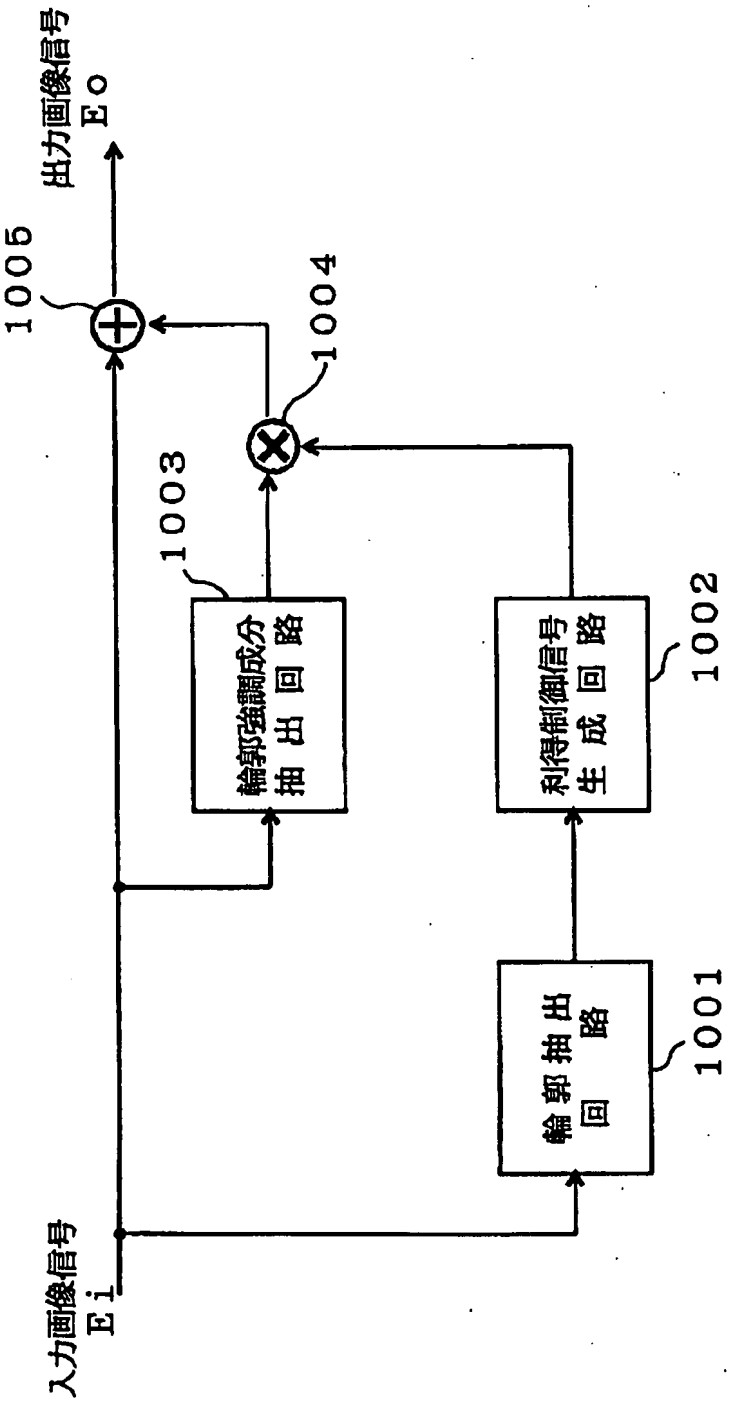
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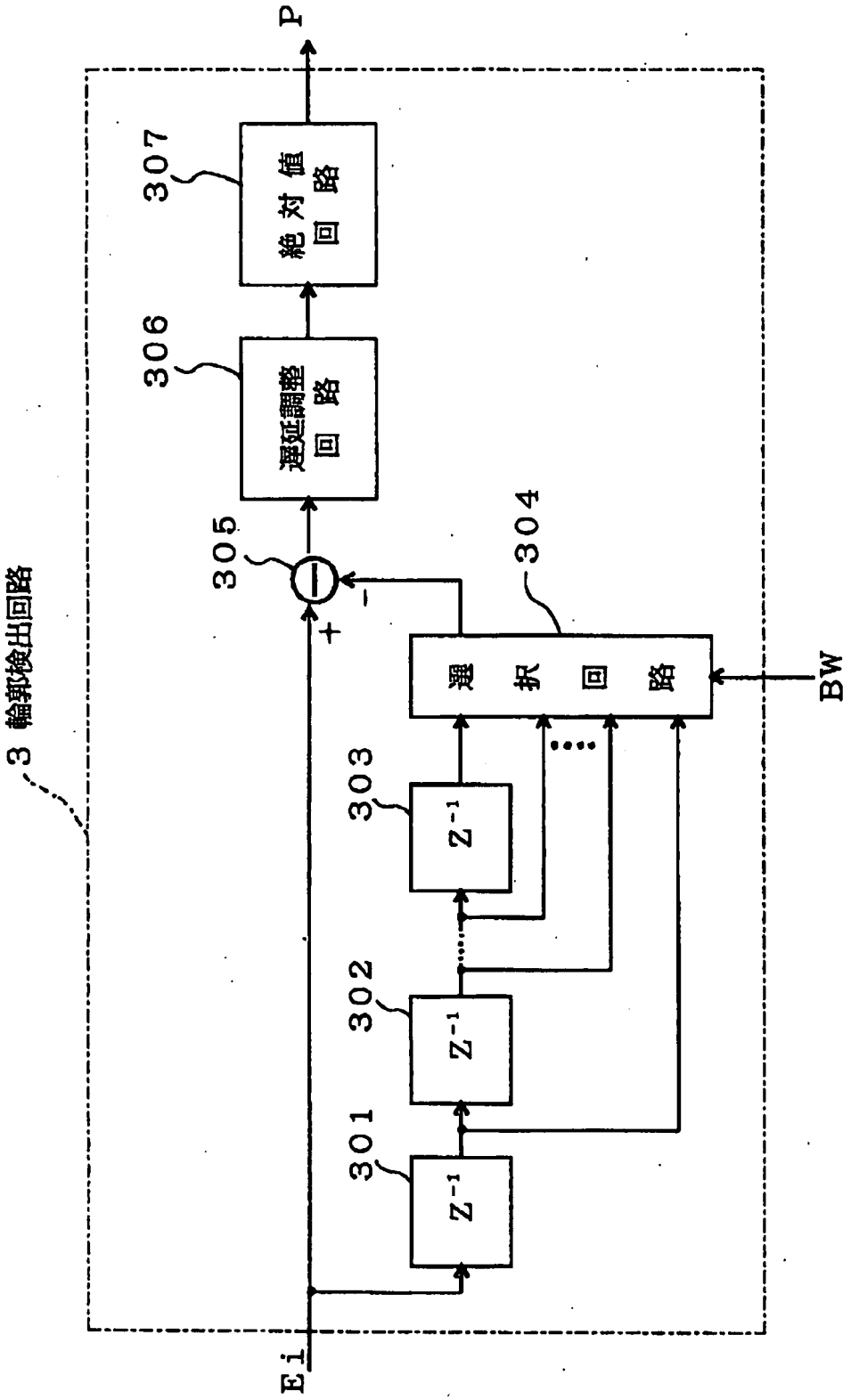
[Drawing 4]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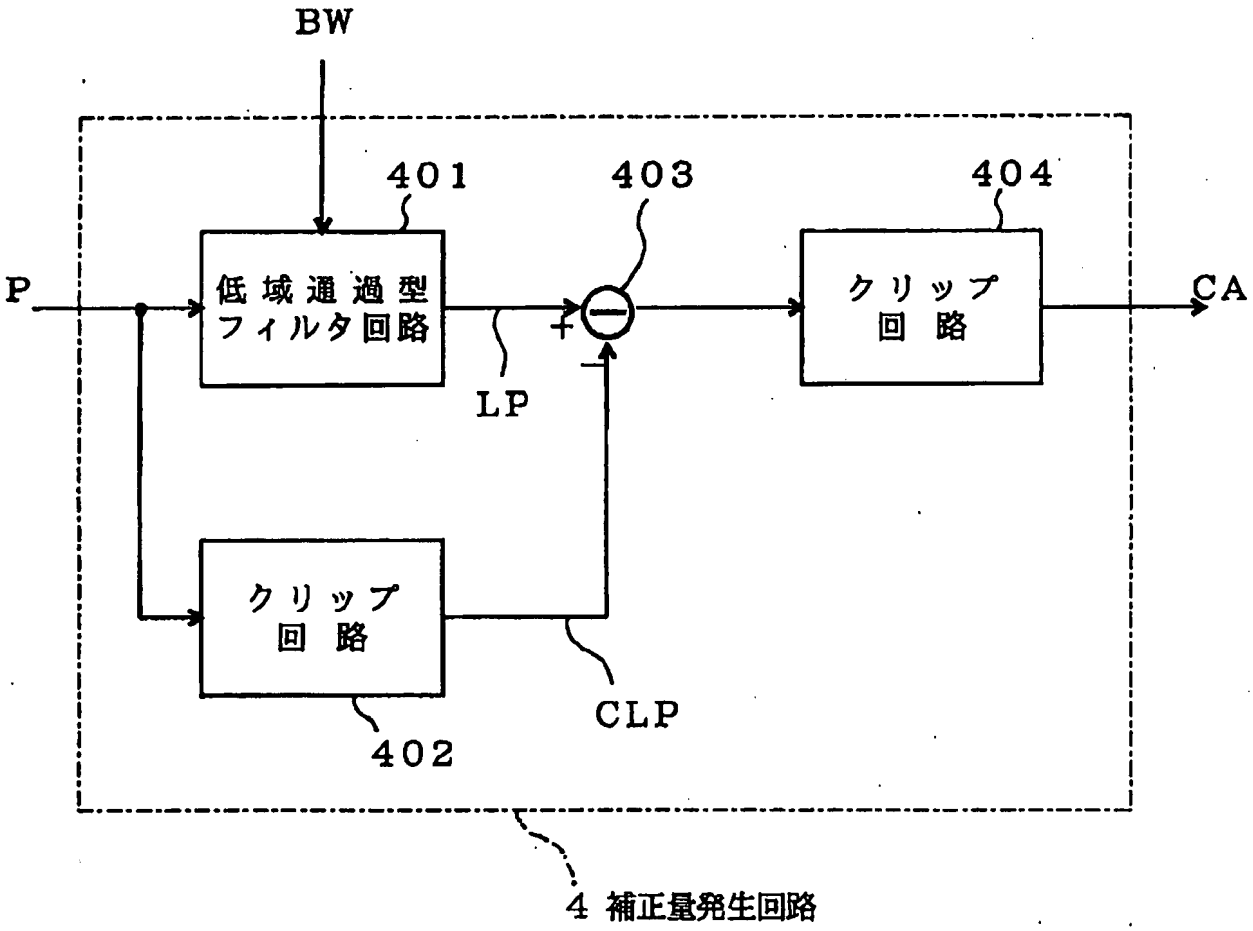
[Drawing 5]



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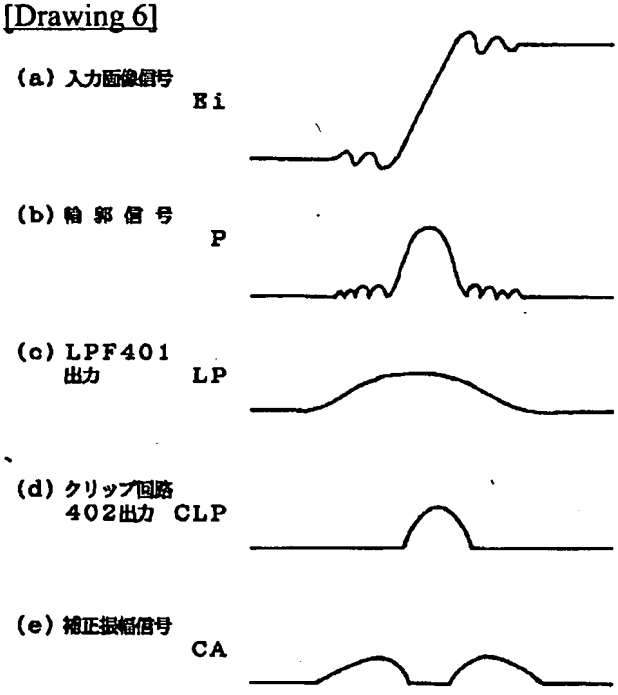

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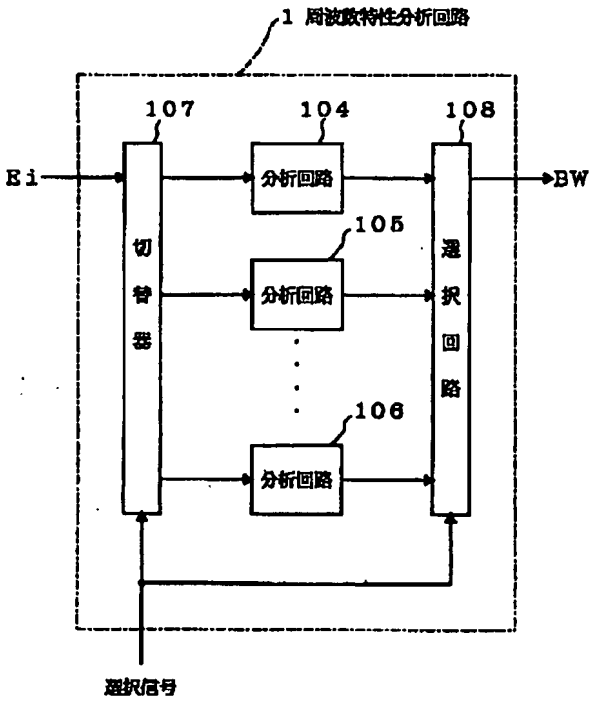
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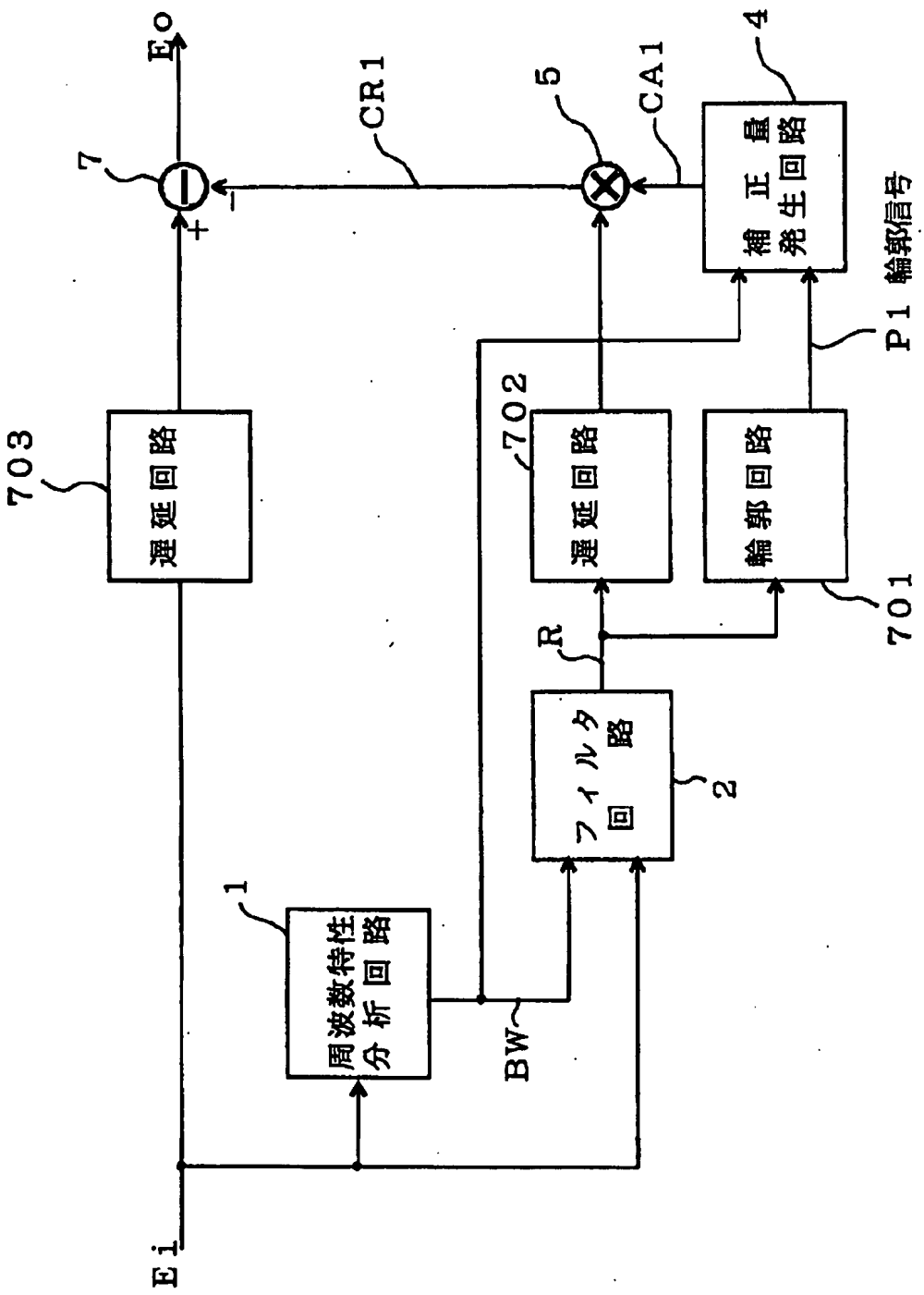
[Drawing 7]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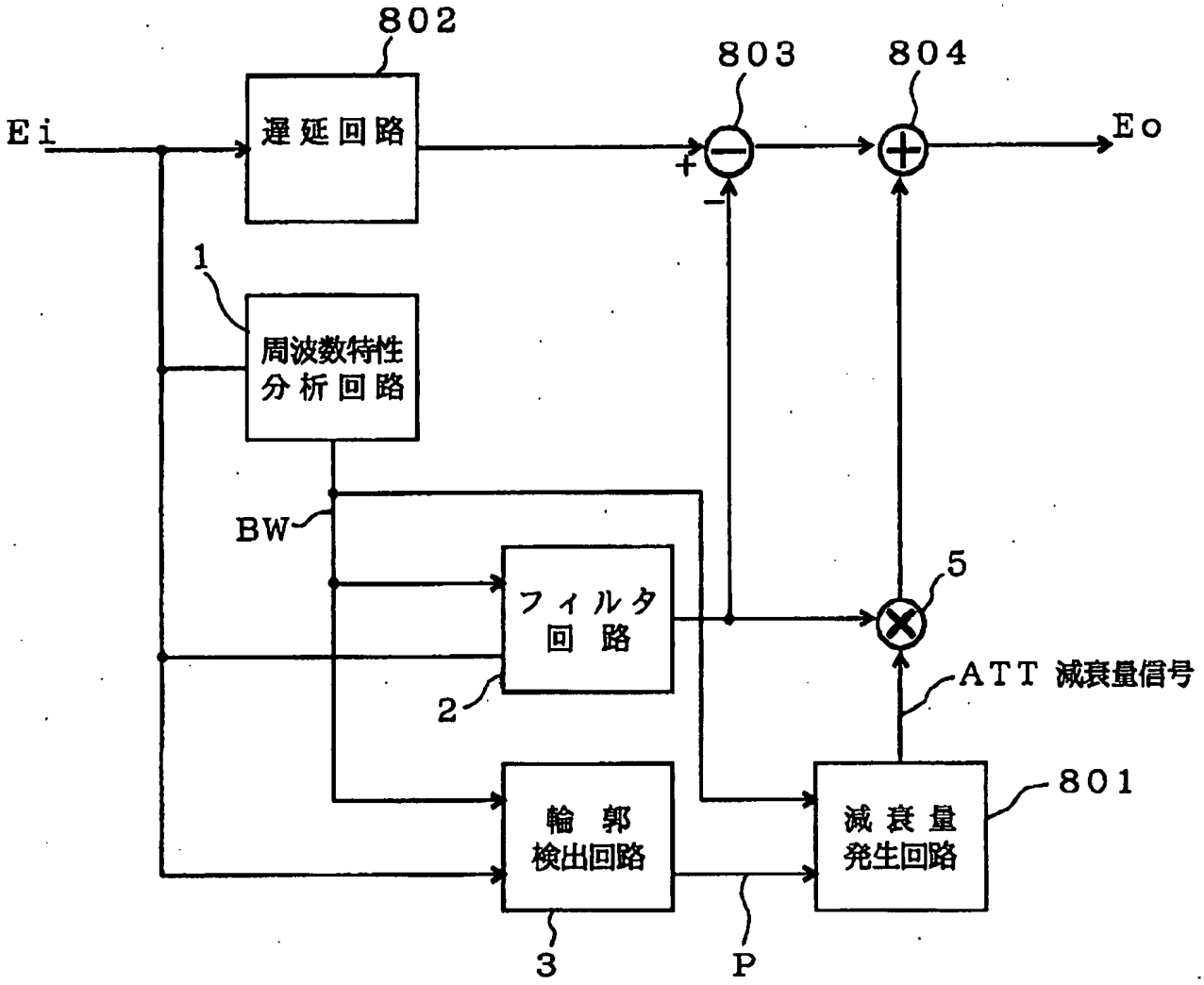
[Drawing 8]



[Translation done.]